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(54) Safety device for a door  
 fastening

(57) A safety device for preventing  
 opening of the door of a washing  
 machine during operation thereof,  
 comprises a spring-loaded sliding bolt  
 member (12) which blocks movement  
 of the handle (9) of the door (7) of the

machine when moved in direction B  
 by a solenoid (15).

A further solenoid (21) holds the  
 bolt member in its fastening position.

Unlocking of the door (7) occurs  
 only at the end of a cycle after a  
 delay caused by a bimetal (not shown)  
 to allow the drum to stop. An auxiliary  
 capacitive circuit releases the  
 fastening if the power falls.

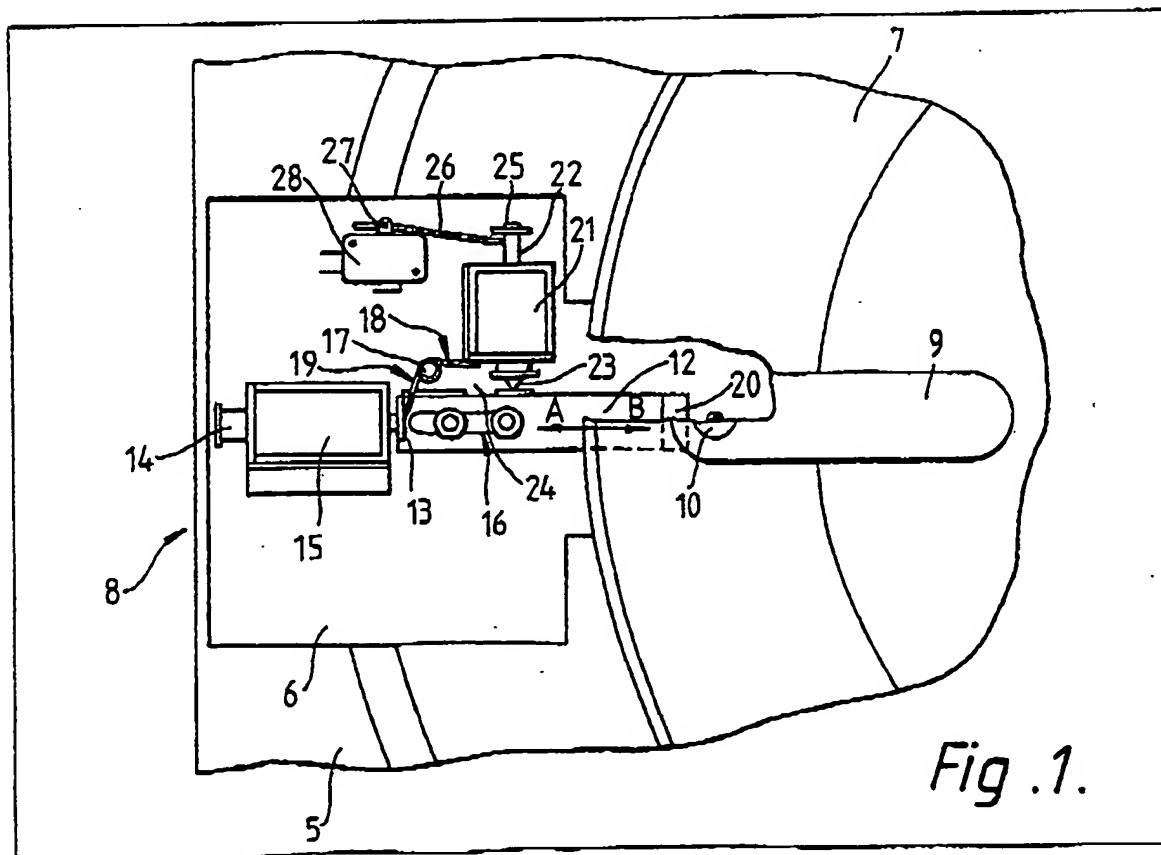


Fig. 1.

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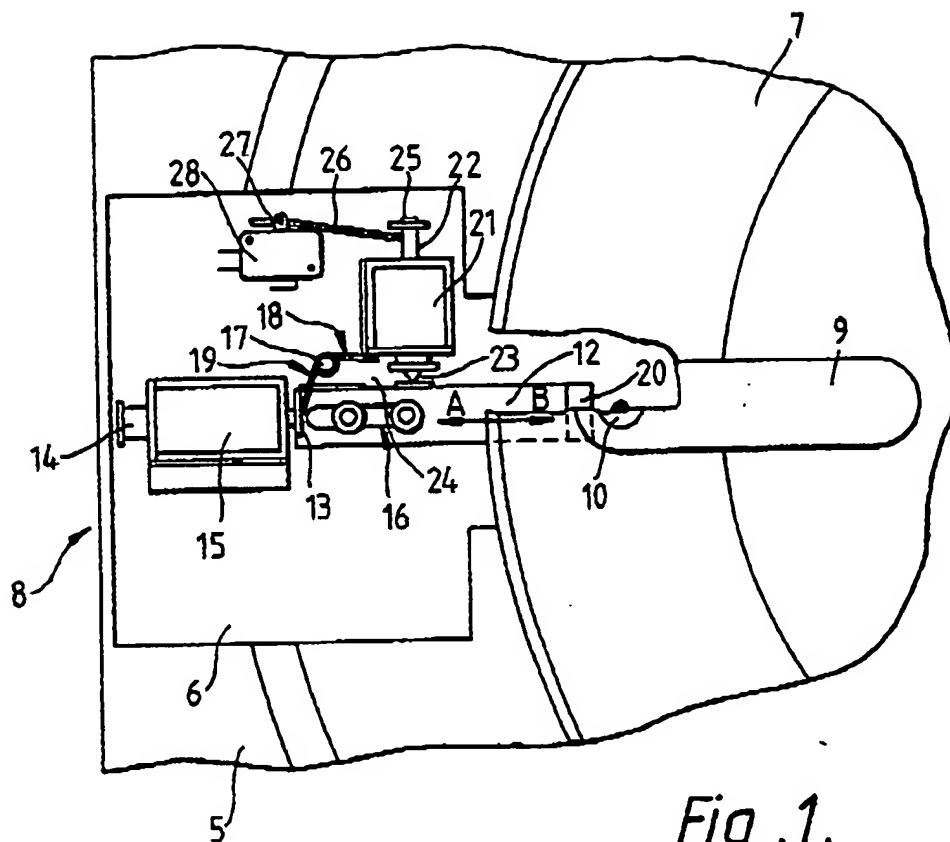


Fig. 1.

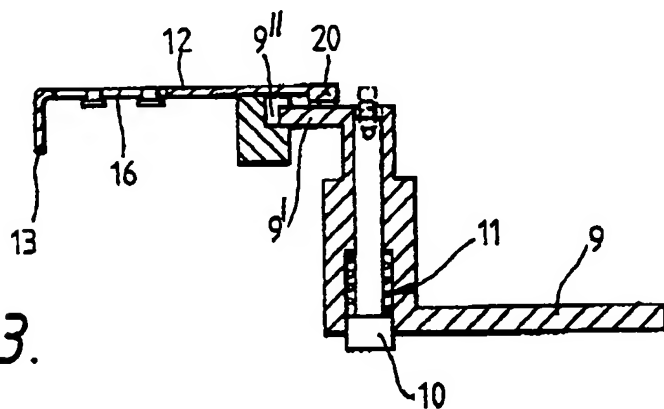


Fig. 3.

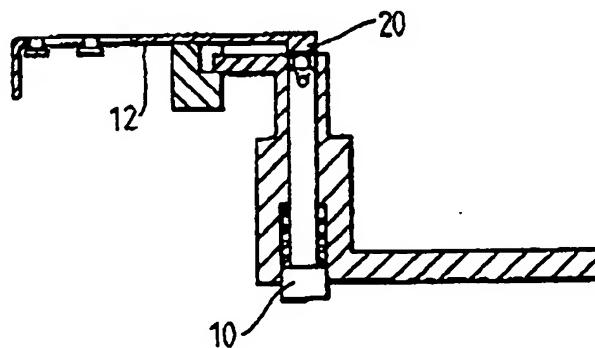


Fig. 4.

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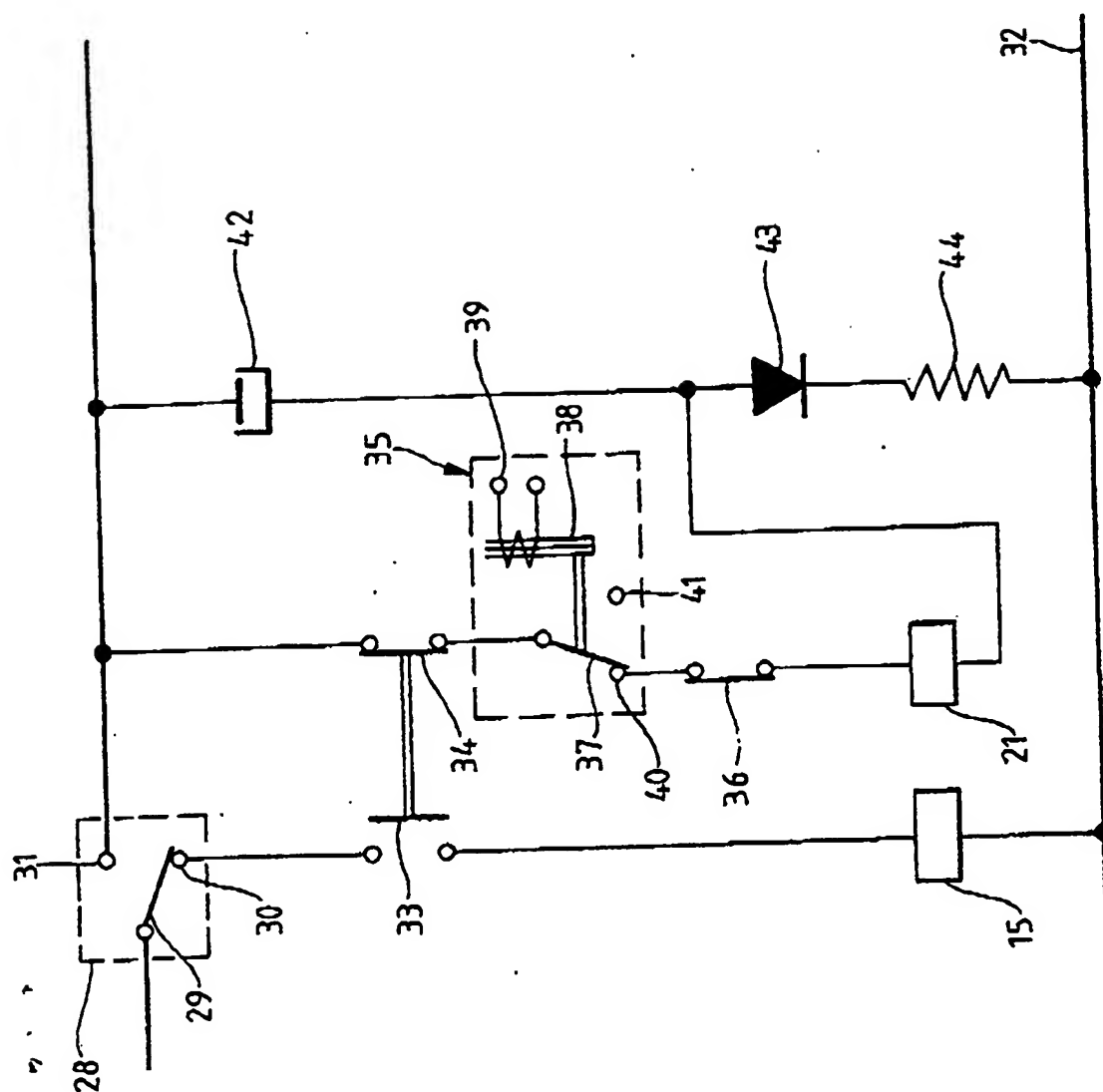
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Fig. 2.

## SPECIFICATION

## Safety device for opening a door

The invention relates to a safety device for opening of the door of washing machines or the like, applicable in particular to industrial uses.

Washing machines for domestic use and those for industrial use are conventionally provided with safety devices of various types (electromagnetic, hydraulic, pneumatic, etc.), to prevent injury to persons while the operating cycle of the machine is being carried out, by causing the door to be closed throughout the period for which the machine is operating, and permitting the door to be opened only when the machine is stopped or at least when the speed of the drum has fallen below a predetermined value. In particular, washing machines for industrial uses are normally provided with electromechanical safety devices which essentially comprise a latch bolt member which is actuable by a solenoid, and an optional device for delaying opening of the door, of per se known type.

In one conventional form, the latch bolt member is mounted on a plate which can be fixed to the front part of the casing of the washing machine, in a position adjacent to the door, and is movable from a rest position in which the door may be opened, when the solenoid is de-energised, to an operative position in which opening of the door is prevented and the solenoid is energised, and vice-versa. In turn, the door of the machine is provided with a handle which is connected to the catch of the door for opening and closing the door. The handle is provided with a manually operable push-button which acts on the catch of the door so that it is possible to open the door only by actuating the above-described push-button. The latch bolt member of the door, which is moved into its operative position, takes up a position in which its free end is disposed in the path of movement of the above-mentioned push-button and, by preventing actuation thereof, therefore does not permit the door to be opened. In this way, the washing machine of the above-described construction has effective safety in regard to opening the door, which is achieved both by the latch bolt member acting on the push-button of the door and by the push-button itself, which permits the door to be opened only when it is manually actuated.

As regards the solenoid, this must remain continuously energised in order to hold the latch bolt member permanently in the position of locking the door, for a period of time corresponding to the duration of the entire washing cycle of the machine. In consequence, while this design provides satisfactory protection for the machine, in time correct operation of the solenoid may be detrimentally affected as it is always operating under voltage.

According to the present invention, there is provided a safety device for opening of the door of a washing machine, said door being provided with a handle and a spring-loaded latch bolt member

actuated by a solenoid and co-operating with said handle, the device comprising an auxiliary supply circuit of capacitive type, bimetal delay means, an actuating circuit connected in parallel with said auxiliary supply circuit, and a switching element capable of connecting said actuating circuit and said solenoid alternately in parallel to the mains, by way of respective contacts actuated by a programmer of the machine.

As will be apparent from the following description the invention can provide a safety device such as to ensure reliable locking of the door of the machine throughout the duration of the washing cycle, by using at least two solenoids which mechanically interact with each other, which are energised respectively only at the beginning and at the end of the washing cycle or by manual actuation of the controls of the machine while the cycle is being carried out, and are de-energised while the cycle is being performed. If, while the machine is operating, an interruption in the electrical power supply should occur for any reason, with the proposed design it is still possible to energise the solenoid in order to unlock the present door safety device.

The features and advantages of the invention will be more clearly apparent from the following description which is given solely by way of non-limiting example, and with reference to the accompanying drawings in which:

Figure 1 is a front view of part of a washing machine on which a safety device according to the invention has been fitted;

Figure 2 shows the electrical circuit diagram of one form of safety device according to the present invention;

Figure 3 is a diagrammatic view of the safety device in the rest position; and

Figure 4 is a diagrammatic view of the present safety device in the operative position.

Referring to Figure 1, diagrammatically shown therein is a part of the front casing 5 of a front-loading washing machine, in particular for industrial use, to which a plate 6 is fixed in a position adjacent to the door 7 giving access to the drum (not shown) of the machine, with a safety device 8 according to the invention being mounted on the plate 6.

The door 7 is provided with a handle 9 acting on a catch 9' capable of engaging into a corresponding recess 9" (see Figure 3), which is provided laterally of the opening for access to the drum. The handle is in turn provided with a manually actuated push-button 10 arranged to prevent any operation of the handle before the machine has been taken out of operation.

The push-button 10 is engaged by a spring 11 and co-operates with the catch 9' by way of a series of mechanical members (known and not shown) in such a way that it is only when the push-button is pressed against the force of the spring 11 that the catch 9' can be engaged into and disengaged from the recess 9", by turning the handle 9.

The present safety device 8 substantially

comprises a latch bolt member 12 provided with a first bent end 13 to which there is connected the movable armature 14 of a first solenoid 15, and a pin-and-slot system 16 for permitting the latch bolt member 12 to slide in the longitudinal direction, in the directions indicated by arrows A and B.

The plate 6 is also provided with a projecting pin or stud 17 on which a spring 18 is wound. The end 19 of the spring bears against the bent end 13 of the latch bolt member 12 whereby it continuously urges the latch bolt member in the direction indicated by arrow A.

When the solenoid 15 is energised, the armature 14 is attracted and pushes the latch bolt member 12 in the direction B towards its operative position in which the other end 20 of the latch bolt member is moved into a condition of association with the push-button 10, thereby preventing actuation thereof.

Disposed above the latch bolt member 12 is a second solenoid 21 which is provided with a movable armature 22 which can be displaced in a vertical direction and which acts against the upper surface of the latch bolt member 12, by way of the lower end 23 of the armature 22, which is of a conical configuration.

In particular, the armature 22 is moved by gravity into its downward operative position, and may be returned into the raised rest position when the solenoid 21 is energised.

In turn, the latch bolt member 12 is provided on its top with a recess 24 which is positioned in line with the end 23 of the armature 22 only when the latch bolt member has been moved into its operative position. The upper end 25 of the armature 22 acts against a lever arm 26 which is pivoted at a pivot point 27 of a two-position switch 28 in such a way that movement of the armature actuates the switch into two different operative positions.

Figure 2 shows the electrical circuit diagram of the safety device of the present invention, from which it will be seen that the switch 28 has a movable contact 29 which is movable under the weight of the armature from a first rest position in which it is connected to the fixed contact 30, to a second, operative position in which it is connected to the fixed contact 31.

The coil of the first solenoid 15 is connected between the fixed contact 30 of the switch 28 and a conductor 32 of the electrical power supply of the machine, by way of a first electrical contact 33 which is actuatable by the programmer of the machine.

The coil of the second solenoid 21 is connected by one terminal to the fixed contact 31, in series with a second electrical contact 34 which is actuatable by the programmer of the machine, a device 35 for delaying opening the door, and at least one movable contact 36 which is associated with a remote-control switch (not shown) connected to the electric motor (not shown) of the machine.

The delay device 35 comprises an electrical

contact 37 which is actuatable by at least one bimetal element 38 of conventional type, associated with a respective heater coil 39 connected in parallel to the high-speed control of the motor and possibly also the supply for the programmer of the machine.

In this way, when the bimetal element 38 is heated above a given temperature, by the current circulating in the associated heater coil 39, the contact 37 is actuated, moving from the contact 40 to the contact 41.

The delay device 35 is calibrated in such a way that the time required by the bimetal element 38 to move the contact 37 from the fixed contact 41 back to the fixed contact 40 corresponds to the delay time required for the drum, at high speed, to come to a halt, that time being calculated from the moment at which the electrical power supply of the machine was interrupted.

The contact 36 is associated with the other contacts (not shown) of the remote-control switch and is actuated in such a way as to be closed when said other contacts are opened and thus the motor is not supplied with power, and to be opened when said other contacts are closed and thus the motor is supplied with power, thereby ensuring that the door of the machine is opened only when the motor is not supplied with power.

The other terminal of the coil of the solenoid 21 is connected in parallel to a circuit comprising at least one high-capacitance capacitor 42, a polarisation diode 43 and a limiting resistor 44; that circuit is in turn connected between the fixed contact 31 and the conductor 32. This circuit is identical to that described in the present applicants' patent application No. 45713-A/77 filed on 21st April 1977 and, similarly thereto, is provided for the purpose of ensuring that the door of the machine can be opened even upon failure of the electrical power supply during operation of the machine, as will be seen in greater detail hereinafter.

The above-described safety device operates in the following manner:

Before starting the cycle of the machine, the electrical contact 33 is in the open position while the contact 34 is in the closed position (see Figure 2). In turn, the first solenoid 15 is de-energised and the latch bolt member 12 is thus moved into the rest position, in which the recess or opening 24 therein is not in alignment with the movable armature 22, disposed thereabove, of the second solenoid 21.

As can be seen from Figure 2, in this position the end 20 of the latch bolt member 12 does not interfere with movement of the push-button 10 of the handle 9, so that opening of the door is not prevented. Consequently, the armature 22 is in the upward rest position in which its upper end 25 actuates the movable contact 29 of the switch 28 and holds it to the fixed contact 30 (Figure 2). As soon as all the laundry to be washed has been introduced into the drum of the machine, the door 7 is closed by acting on the handle 9 thereof, with consequent closure of the door micro-switch (not

shown) which supplies power to the electrical components of the machine.

When the machine is started, after suitable program selection, the contact 33 is closed and the contact 34 is opened, and consequently the first solenoid 15 is energised, the armature 14 of which moves the latch bolt member 12 into the operative position in which the recess 24 therein is disposed in alignment with the end 23 of the armature 22 of the second solenoid 21.

The end 23 of the armature 22 then engages by gravity into the recess 24, thus preventing the return movement of the latch bolt member which is engaged by the spring 18. As can be seen from Figure 4, the latch bolt member 12, when moved into the above-defined position, has its end 20 extending into the path of movement of the above-mentioned push-button and, by not permitting movement thereof, definitively prevents the door from being opened.

The movement of the armature 22 into its downward operative position switches the movable contact 29 to the fixed contact 31, by means of the upper end 25 of the armature 22, whereby the first solenoid 15 is de-energised (see Figure 2). In this condition also the second solenoid 21 is de-energised, as the contact 34 is open.

When the latch bolt member 12 is actuated in this manner, it holds the door safely locked in the closed position, preventing any opening thereof when the machine is in operation. In addition, in this case both the solenoids 15 and 21 are de-energised and are energised only for a brief period of the cycle, respectively at the beginning and at the end of the cycle, or by manual operation of the controls of the machine while the cycle is being performed. It follows from this that the solenoids are less subject to trouble and are definitively found to be more reliable in operation in comparison with the solenoids which were previously used.

At the conclusion of the cycle, the programmer of the machine closes the contact 34 and opens the contact 33.

In this condition, the contact 37 which is moved by the bimetal element 38 to the fixed contact 41, by virtue of the heating action produced by the coil 39 which was energised during the operating cycle, after a predetermined delay time, is returned by the bimetal element to the fixed contact 40, in accordance with the procedure described hereinbefore.

The contact 36 is closed since the remote-control switches are in a rest position in which the motor is disconnected, whereby the second solenoid 21 is energised and the armature 22 thereof is lifted into the rest position, thereby disengaging the end 23 from the latch bolt member 12.

The latch bolt member 12 is therefore returned to the rest position by the spring 18 (movement in the direction indicated by arrow A) and permits the push-button 10 of the handle 9 to be actuated.

In consequence, the end 25 of the armature 22

actuates the movable contact 29 of the switch 28 and switches it to the fixed contact 30, whereby in that position both the solenoids 15 and 21 are de-energised.

This device makes it possible to achieve effective safety for the machine, even in the event of damage to one of the solenoids 15 and 21.

In fact, if, while the machine is operating, the solenoid 15 should become damaged, the latch bolt member 12 will remain engaged by the end 23 of the armature 22, holding the door in the locked position, while it would no longer be possible to start further cycles without first replacing that solenoid.

If, while the machine is operating, the solenoid 21 should suffer damage, the latch bolt member 12 would remain locked by the end 23 of the armature 22 which is moved downwardly by gravity, and would also hold the door in a locked condition, permitting release thereof only by external action on the latch bolt member.

Finally, the presence of the circuit including the capacitor 42, the polarisation diode 43 and the limiting resistor 44 will ensure operation of the present safety device even in the event of a failure in the electrical power supply during operation of the machine, by virtue of the pulses supplied by the capacitor 42, which energise the solenoid 21. In fact, in that case, the capacitor 42 which is charged up during operation of the machine is discharged at the end of the cycle through the coil of the second solenoid 21, whereby the solenoid can again return the latch bolt member 12 into the rest position, in accordance with the procedure described hereinbefore.

#### CLAIMS

1. A safety device for opening of the door of a washing machine said door being provided with a handle and a spring-loaded latch bolt member actuated by a solenoid and co-operating with said handle, the device comprising an auxiliary supply circuit of capacitive type, bimetal delay means, an actuating circuit connected in parallel with said auxiliary supply circuit and a switching element capable of connecting said actuating circuit and said solenoid alternately in parallel to the mains, by way of respective contacts actuated by a programmer of the machine.

2. A safety device according to claim 1 wherein said actuating circuit comprises a further solenoid in series with at least one normally closed contact associated with a supply remote-control switch of the motor of the machine, and a movable contact associated with said delay means.

3. A safety device according to claim 2 wherein said further solenoid is provided with a movable armature co-operating with said switching element and capable of engaging by gravity with its lower end into a recess provided in said latch bolt member when the latch bolt member is in a rest position, and capable of disengaging from the latch bolt member by the action of the solenoid when the latch bolt member is in an operative position.

4. A safety device for opening of a door, such device being constructed and arranged to operate substantially as hereinbefore described with reference to the accompanying drawings and for

5 the purposes set forth.

5. A washing machine having a device according to any one of the preceding claims.

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